

Amendments to the Claims:

1. (Currently Amended) A method for use of a computer-assisted surgery system during a medical procedure, comprising:

receiving information on an object of interest;

tracking a position of a tool of a haptic device;

5 determining a scalar distance between a current position of said tool and said object of interest; and

providing an indication of said scalar distance to a user of said tool,

wherein the object of interest includes at least one haptic virtual object that represents a virtual cutting boundary for the tool and that is defined by at least one of at least in part by:

a mapping between a pose of the tool and an output wrench of the haptic device, and,

~~a mapping between a wrench applied by the user to the haptic device and an output position of the haptic device~~

15 ~~wherein providing the indication of the scalar distance includes activating at least one actuator of the haptic device to generate the output wrench when the tool intrudes on the virtual cutting boundary.~~

2. (Currently Amended) A method for use of a computer-assisted surgery system during a surgical procedure, the method comprising:

~~receiving displaying~~ information on an anatomical target region of a patient on which the surgical procedure is to be performed to remove tissue;

5 ~~defining a virtual cutting boundary for the surgical tool relative to the anatomical target region, the virtual cutting boundary being defined to a mapping between a pose of the surgical tool and an output wrench of the haptic device;~~

tracking a position of a tissue removing surgical tool of a haptic device as the surgical tool is moved by a surgeon in performing the surgical procedure;

10 ~~displaying a representation of the surgical tool as the surgical tool moves during the surgical procedure;~~

determining a distance between a current position of said surgical tool and the anatomical target region; and

- providing to the user of the surgical tool an indication of said distance,
15 wherein the anatomical target region is associated with at least one haptic object defined by at least one of: a mapping between a pose of the surgical tool and an output wrench of the haptic device activating at least one actuator of the haptic device to generate the output wrench based on the tracked position of the surgical tool and the mapping, and
20 a mapping between a wrench applied by the user to the haptic device and an output position of the haptic device,
wherein pose connotes position, orientation, velocity, and/or acceleration, and
25 wherein wrench connotes forces and/or torques.

3. (Original) The method of claim 2, further comprising, prior to said providing step, selecting a type of visual indication to provide to said user.

4. (Previously Presented) The method of claim 2, wherein said indication is provided by a visual indicator selected from the group consisting of a level meter, a dial, a numerical display, and a graph.

5. (Previously Presented) The method of claim 2, wherein said providing step comprises providing a visual indication of said distance on a display device associated with a computer-assisted surgery system.

6. (Previously Presented) The method of claim 2, wherein said providing step comprises providing a visual indication of said distance on a display device disposed on the haptic device associated with said computer-assisted surgery system.

7. (Previously Presented) The method of claim 2, wherein said providing step comprises providing a visual indication of said distance on a display

device disposed on the surgical tool in proximity to the anatomical target region of the patient.

8. (Previously Presented) The method of claim 3, further comprising selecting a color for said visual indication based at least in part on a scalar distance.

9. (Previously Presented) The method of claim 3, further comprising, prior to said providing step, selecting said visual indication based at least in part on said distance.

10. (Previously Presented) The method of claim 1, wherein the haptic object includes a definition of a desired shape for an anatomy of a patient.

11. (Cancelled)

12. (Currently Amended) The method of claim 1, wherein said haptic object includes a definition of [[of]] a curve, a point, a surface, a volume, and a set of desired positions.

13. (Previously Presented) The method of claim 2, wherein said providing step further includes providing a predetermined visual indication indicating that said distance is within an acceptable range.

14. (Previously Presented) The method of claim 2, wherein said providing step further includes providing a predetermined visual indication indicating that said distance is in an unacceptable range.

15. (Currently Amended) A method for use of a computer-assisted medical system during a medical procedure, comprising:

receiving information on an object of interest;
tracking a position of a tool of a haptic device;

5 determining a scalar distance between a current position of said tool
and said object of interest; [[and]]

~~providing a tactile indication of said scalar distance to said user of said
tool,~~

10 wherein the object of interest includes at least one virtual haptic object
that represents a virtual cutting boundary for the tool, the virtual haptic object being
defined at least in part by at least one of:

 a mapping between a pose of the tool and an output
wrench of the haptic device[[],]; and

15 providing to a user of the surgical tool tactile feedback indicative of
said scalar distance between the tool and the virtual cutting boundary, the tactile
feedback including generating the output wrench via the haptic device

a mapping between a wrench applied by the user to the
haptic device and an ouput position of the haptic device.

16. (Original) The method of claim 1, wherein said providing
step further comprises causing vibration of a device that is in contact with said user.

17. (Original) The method of claim 1, further comprising
selecting a type of indication based at least in part on said scalar distance.

18. (Currently Amended) The method of claim 1, wherein said
providing step comprises ~~providing said indication~~ indicating that said scalar distance
is within an acceptable range.

19. (Currently Amended) The method of claim 1, wherein said
providing step comprises ~~providing said indication~~ indicating that said scalar distance
is in an unacceptable range.

20. (Cancelled)

21. (Currently Amended) A method for use of a computer-assisted surgery system during a medical procedure, comprising:

receiving and displaying information on an object of interest and a virtual guide surface;

5 tracking a current position of a tool of a haptic device as the tool moves relative to the object of interest and the virtual guide surface;

displaying the current position of the tool relative to the object of interest and the virtual guide surface;

determining a current scalar distance between the current position of
10 said tool and said object of interest virtual guide surface; [[and]]

providing an audio signal which changes as the scalar distance changes to provide audio indication of said current scalar distance to a user of said tool[[],];

~~wherein said object of interest includes at least one haptic object defined by at least one of:~~

15 ~~a mapping between a pose of the tool and an output wrench of the haptic device, and~~

~~a mapping between a wrench applied by the user to the haptic device and an output position of the haptic device~~

providing force feedback to a user via the haptic device which at least
20 one of:

attracts the tool toward one of the object and the virtual guide surface,

repels the tool from the virtual guide surface, and
regulates a speed of moving the tool relative to the object.

22. (Original) The method of claim 21, further comprising, prior to said providing step, selecting a type of audio indication to provide to said user.

23. (Original) The method of claim 21, wherein said providing step comprises providing said audio indication of said scalar distance via an audio device associated with a computer-assisted surgery system.

24. (Previously Presented) The method of claim 21, wherein said providing step comprises providing said audio indication of said scalar distance via an audio device disposed on the haptic device associated with a computer-assisted surgery system.

25. (Previously Presented) The method of claim 21, wherein the audio signal changes proportionately to changes in said current scalar distance.

26. (Original) The method of claim 21, further comprising, prior to said providing step, selecting said audio indication based at least in part on said scalar distance.

27. (Currently Amended) The method of claim 21, wherein said ~~haptic object~~virtual cutting boundary defines a desired shape for an anatomy of a patient.

28. (Cancelled)

29. (Cancelled)

30. (Previously Presented) The method of claim 21, wherein said providing step further includes providing a predetermined audio indication indicating that said scalar distance is within an acceptable range.

31. (Previously Presented) The method of claim 21, wherein said providing step further includes providing a predetermined audio indication indicating that said scalar distance is in an unacceptable range.

32. (Currently Amended) A computer-assisted surgery system for use during a medical procedure, comprising:

a processor programmed with application logic operatively associated with said computer-assisted surgery system and operable to:

5 receive information on an object of interest located in
an internal anatomy of a patient on whom the procedure is performed,
the object of interest including a virtual cutting boundary for guiding a
surgical tool;

10 track the position of [[a]] the surgical tool of a haptic
device as the surgical tool moves relative to the object of interest at
least in part through the internal anatomy of the patient during the
medical procedure;

determine a current scalar distance between a current
position of said tool and said object of interest; and

15 control at least one actuator of the haptic device to
generate an output force or torque which varies with said current scalar
distance to provide an indication of said current scalar distance to a
user of said surgical tool which indication changes during the medical
procedure as the surgical tool moves through the internal anatomy of
20 the patient[[],]; and

~~wherein said object of interest includes at least one haptic object~~
~~defined by at least one of:~~

~~a mapping between a pose of the surgical tool and an~~
~~output wrench of the haptic device, and~~

25 ~~a mapping between a wrench applied by the user to the~~
~~haptic device and an output position of the haptic device~~

a display which displays a representation of at least a portion of the
internal anatomy, the object of interest, and the tool.

33. (Original) The system of claim 32, wherein said application logic is further operable to provide a visual indication of said scalar distance to said user of said tool.

34. (Original) The system of claim 33, wherein said application logic is further operable to select a type of visual indication to provide to said user.

35. (Original) The system of claim 33, wherein said visual indication is provided by a visual indicator selected from the group consisting of a level meter, a dial, a numerical display, and a graph.

36. (Original) The system of claim 33, wherein said application logic is further operable to provide said visual indication of said scalar distance on a display device associated with said computer-assisted surgery system.

37. (Previously Presented) The system of claim 33, wherein said application logic is further operable to provide said visual indication of said scalar distance on a display device disposed on the haptic device .

38. (Currently Amended) A computer assisted surgery system for use during a surgical procedure, comprising:

5 a surgical tool of a haptic device for performing the surgical procedure on an anatomy of a patient to remove tissue, the haptic device including at least one activator which is activated to generate an output wrench, and the surgical tool including a display device;

a tracking system which tracks movement of the surgical tool during the surgical procedure; and

10 application logic operatively associated with said computer-assisted surgery system and operable to:

receive information about an object of interest in the anatomy of the patient, the object of interest including at least one haptic object that represents a virtual cutting boundary for the tool;

15 receive tool position information from the tracking system;

determine a distance between a current position of said tool and said object of interest; and

provide indication of said distance on the display device disposed on the surgical tool;

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actuate the at least one actuator of the haptic device to generate the output wrench in accordance with said scalar distance;

wherein the ~~object of interest includes~~ at least one haptic object is defined by ~~at least one of:~~ a mapping between a pose of the surgical tool and [[an]] the output wrench of the haptic device[[, and]]

25

a mapping between a wrench applied by the user to the haptic device and an output position of the haptic device.

39. (Original) The system of claim 34, wherein said application logic is further operable to select a color for said visual indication based at least in part on said scalar distance.

40. (Previously Presented) The system of claim 33, wherein said application logic is further operable to select a plurality of visual indications based at least in part on said scalar distance.

41. (Cancelled)

42. (Previously Presented) The system of claim 33, wherein said haptic object defines a portion of the anatomy of the patient which is to be removed by the surgical tool during the medical procedure.

43. (Previously Presented) The system of claim 33, wherein said haptic object includes at least one of a defined curve, point, surface, volume, and set of desired positions.

44. (Original) The system of claim 33, wherein said application logic is further operable to provide a predetermined visual indication indicating that said scalar distance is within an acceptable range.

45. (Original) The system of claim 33, wherein said application logic is further operable to provide a predetermined visual indication indicating that said scalar distance is in an unacceptable range.

46. (Original) The system of claim 32, wherein said application logic is further operable to provide a tactile indication of said scalar distance to said user of said tool.

47. (Original) The system of claim 32, wherein said application logic is further operable to cause vibration of a device in contact with said user.

48. (Original) The system of claim 32, wherein said application logic is further operable to select a type of indication based at least in part on said scalar distance.

49. (Original) The system of claim 32, wherein said application logic is further operable to provide said indication indicating that said scalar distance is within an acceptable range.

50. (Original) The system of claim 32, wherein said application logic is further operable to provide said indication indicating that said scalar distance is in an unacceptable range.

51. (Cancelled)

52. (Currently Amended) A computer-assisted surgery system for use during a medical procedure, comprising:

application logic operatively associated with said computer-assisted surgery system and operable to:

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receive information on an object of interest;

track position changes of a moveable medical tool of a haptic device;

10 determine a current scalar distance between a current position of said tool and said object of interest as the tool moves relative to the object during the medical procedure; and

15 provide an audio indication of said current scalar distance to said user of said tool,

15 wherein the object of interest includes at least one haptic object virtual cutting boundary for the tool which is defined at least in part by at least one of a mapping between a pose of the medical tool and an output wrench of the haptic device, and

20 wherein providing the indication of scalar distance includes actuating at least one actuator of the haptic device to generate the output wrench when the tool intrudes on the virtual cutting boundary

20 a mapping between a wrench applied by the user to the haptic device and an output position of the haptic device.

53. (Original) The system of claim 52, wherein said application logic is further operable to select a type of audio indication to provide to said user.

54. (Original) The system of claim 52, wherein said application logic is further operable to provide said audio indication of said scalar distance via an audio device associated with said computer-assisted surgery system.

55. (Previously Presented) The system of claim 52, wherein said application logic is further operable to provide said audio indication of said scalar distance via an audio device disposed on the haptic device associated with said computer-assisted surgery system.

56. (Original) The system of claim 52, wherein said application logic is further operable to provide said audio indication of said scalar distance via an audio device disposed on a surgical tool used in proximity to an anatomy of a patient.

57. (Original) The system of claim 52, wherein said application logic is further operable to select said audio indication based at least in part on said scalar distance.

58. (Previously Presented) The system of claim 52, wherein the haptic object includes a definition of a desired shape for an anatomy of a patient.

59. (Cancelled)

60. (Cancelled)

61. (Original) The system of claim 52, wherein said application logic is further operable to provide a predetermined audio indication indicating that said scalar distance is within an acceptable range.

62. (Original) The system of claim 52, wherein said application logic is further operable to provide a predetermined audio indication indicating that said scalar distance is in an unacceptable range.

63. (Original) The system of claim 52, wherein said application logic comprises computer executable software code.

64. (Previously Presented) The system of claim 32, wherein the surgical tool removes bone material and the haptic object includes a definition of a surface of bone to be left after a bone material removal procedure.

65. (Cancelled)

66. (Currently Amended) A computer readable medium programmed with instructions which when executed by a programmable device cause the programmable device to execute the steps of:

receiving information on an object of interest;

5 determining a current position of a surgical tool of a haptic device used
in performing a surgical procedure;

determining a scalar distance between the current position of said
surgical tool and said object of interest; and

10 providing a changing indication of said scalar distance to a user of said
surgical tool as the surgical tool removes tissue during the surgical procedure,

wherein the object of interest includes at least one virtual haptic object
that represents a virtual cutting boundary for the tool and that is defined by at least
one of: a mapping between a pose of the tool and an output wrench of the haptic
device, and

15 wherein the programmable device further executes the steps of
actuating at least one actuator of the haptic device in accordance with the scalar
distance to generate the output wrench based on the determined scalar distance and
the mapping

20 ~~a mapping between a wrench applied by the user to the~~
~~haptic device and an output position of the haptic device.~~

67. (Previously Presented) The computer readable medium of
claim 66, wherein said indication is a visual indication.

68. (Previously Presented) The computer readable medium of
claim 66, wherein said indication is an audio indication.

69. (Previously Presented) The computer readable medium of
claim 66, wherein said indication is a tactile indication.

70. (Previously Presented) The computer readable medium of
claim 66, further comprising instructions which when executed by said programmable
device cause the programmable device to execute the step of selecting a type of
indication based at least in part on said scalar distance.

71. (Previously Presented) The computer readable medium of claim 66, further comprising instructions which when executed by said programmable device cause the programmable device to execute the step of providing said indication indicating that said scalar distance is within an acceptable range.

72. (Previously Presented) The computer readable medium of claim 66, further comprising instructions which when executed by said programmable device cause the programmable device to execute the step of providing said indication indicating that said scalar distance is within an unacceptable range.

73. (Cancelled)